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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

August 6 - August 12, 1999

Summary 99-32

Operating Experience Weekly Summary 99-32

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EVENTS

1. OPERATOR RECEIVES ELECTRICAL SHOCK FROM TEMPORARY POWER SUPPLY PANEL

On August 9, 1999, at the Idaho National Environmental Engineering Laboratory Test Reactor Area, a plant utility operator received an electrical shock from a temporary power supply panel that was plugged into a permanently installed 480-V ac receptacle. The shock occurred when the operator touched a permanently installed conduit that contained 115-V ac while touching the temporary panel. Site medical facility personnel examined the operator and determined that he was not injured. The temporary panel belongs to a construction contractor and is used to transform 480-V ac to supply a variety of voltages to several outlets on the panel. Plant electricians determined that the plug on the temporary panel was miswired, causing the panel case to be energized with a 277-V ac potential to ground. They tagged-out the temporary power supply panel and removed it from the building. Unidentified electrical hazards have the potential to cause injuries or a fatality. (ORPS Report ID--LITC-TRA-1999-0022)

Investigators determined that the facility did not have a 220-V ac outlet, so construction personnel used the temporary power supply panel to reduce power from 480 V ac when performing 220-V ac welding activities. Site procedures require the temporary power supply panel to be inspected by an electrical subcontractor every 6 months. Investigators determined that this temporary panel was successfully inspected in June 1999. However, in July construction personnel loaned the panel to an off-site construction contractor. The construction contractor personnel who borrowed the panel told investigators they had changed the plug to a four-prong plug for their use, then changed it back to a three-prong plug before returning the panel. Investigators determined that the off-site contractor personnel incorrectly connected the ground wire to one of the phases when they reinstalled the three-prong plug. Figure 1-1 shows the temporary power supply panel.

Figure 1-1. Temporary Power Supply Panel

The facility manager held a fact-finding meeting. Meeting attendees learned that in addition to the 6-month panel inspection, a daily damage inspection was required. They also learned that there were no administrative controls requiring personnel to maintain exclusive control of portable equipment or to reinspect it if it had not been controlled since the last inspection. The facility manager determined that facility personnel may be unaware of modifications made to equipment loaned to other contractors and may not understand that these potential modifications could affect equipment operating capabilities as well as personnel safety. The facility manager will develop corrective actions as necessary.

NFS reported a similar event in Weekly Summary 98-25 concerning a technician at the Los Alamos National Laboratory Materials Science Complex who received a mild shock while cleaning dust from the outside surface of a resistance furnace oven. Investigators determined that the technician completed a 110-V ac circuit when one of his hands contacted the oven chassis while the other was on another grounded device. An electrical inspector determined that someone had modified the main power cord ground wire, creating an electrical hazard. (ORPS Report ALO-LA-LANL-MATSCCMPLX-1998-0002)

These events illustrate the importance of practicing proper change control and configuration control when equipment modifications are performed. A good configuration control process requires modification testing to ensure that systems continue to perform as required and that safety hazards are not introduced. In this event, electrical personnel had previously tested the equipment to ensure it functioned properly, but construction personnel failed to have it reinspected after they lent it to another contractor. In addition, construction personnel were unaware that the contractor who borrowed the panel modified it. Managers and supervisors should ensure that equipment and tools are (1) approved for use, (2) operated as designed, (3) maintained properly, and (4) inspected periodically.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, "Control of Equipment and System Status," states that DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing.

- DOE-STD-1073-93-Pt.1 and –Pt.2*, Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, provides guidelines and good practices for an operational configuration management program including change control and document control.

KEYWORDS: electrical shock, electrical hazard

FUNCTIONAL AREAS: Industrial Safety, Configuration Control

2. OPERATOR EXPERIENCES HEAT STRESS SYMPTOMS

On August 4, 1999, at the Savannah River Site, an operator working in the F-Canyon warm gang valve corridor experienced symptoms of heat stress after working for approximately one hour in a hot area. The operator complained of feeling lightheaded and had stopped perspiring. The operator left the work area and drank fluids, and the symptoms abated. She returned to her duties the same day. Heat stress effects can range from discomfort to permanent brain damage or death. (ORPS Report SR--WSRC-FCAN-1999-0020)

Investigators determined that work planners had evaluated the work for heat stress risks and discussed heat stress concerns at the pre-job briefing. They determined that the temperature in the work area was 94 degrees Fahrenheit, and the operator was wearing two pairs of protective clothing and a full-face respirator. Investigators believe that the operator was vulnerable to heat stress because she consumed coffee earlier in the day and did not hydrate adequately before entering the work area.

Heat stress occurs when the body has difficulty removing all of the heat generated internally to perform work. Workers are at risk for heat stress if they (1) wear clothing or personal protective equipment that restricts sweat evaporation, (2) experience especially high work demands or, (3) are not acclimatized. Heat stress may also occur if the work area threshold limit for temperature and humidity is exceeded. Radiant heat sources and lack of air movement can also contribute to the risk for heat stress. Workers are at increased risk when they take certain medications or have had a heat-induced illness in the past.

The primary indicator of heat stress is body core temperature. For continuous exposures to heat stress, the goal is to keep core temperature at or below 100.4 degrees Fahrenheit. For intermittent exposures involving experienced, acclimatized workers, 101.3 degrees Fahrenheit is a safe temperature that allows a margin of safety. Often, heart rate increases occur in advance of increases in core temperature. An increasing heart rate may indicate that the body is experiencing difficulty in removing heat. The American Council of Governmental Industrial Hygienists (ACGIH) is considering setting the threshold limit value for a sustained heart rate between 75 and 80 percent of a worker's maximal heart rate.

Core temperature and heart rate lend themselves to objective measurements and decision criteria. Core temperature is difficult to measure in a workplace, so oral temperature may be substituted, allowing that carefully measured oral temperature is about 0.5 degrees centigrade less than core temperature.

NFS reported similar events in past Weekly Summaries related to heat stress. Following are some examples.

- Weekly Summary 98-21 reported that a Waste Management mechanic at the Argonne National Laboratory—East became ill after leaving a decontamination work area. The work area temperature was 90 degrees Fahrenheit, and the mechanic was wearing double coveralls and a supplied air respirator. Paramedics transported the mechanic to a local hospital where physicians diagnosed hypoglycemia and heat cramps. (ORPS Report CH-AA-ANLE-ANLEEMO-1998-0004)

- Weekly Summary 98-08 reported that a maintenance fitter at the Idaho National Environmental Engineering Laboratory was contaminated after he removed his acid suit in a high contamination area. Investigators determined that the fitter removed his acid suit during the job because of heat-stress concerns. This allowed contamination to wick through his perspiration-soaked coveralls and contact his skin. Investigators also determined that exceeding heat stress stay-times contributed to this event. (ORPS Report ID--LITC-WASTEMNGT-1997-0027)

OEAF engineers reviewed heat stress information contained in the DOE Computerized Accident/Incident Reporting System (CAIRS) and found data on 350 instances with an injury code of "Heat Stroke/Other High Temp Effect" dating from 1981. Figure 2-1 shows the correlation between instances of heat stress and month of the year. The figure indicates that there is a significant peak period for such instances in July.

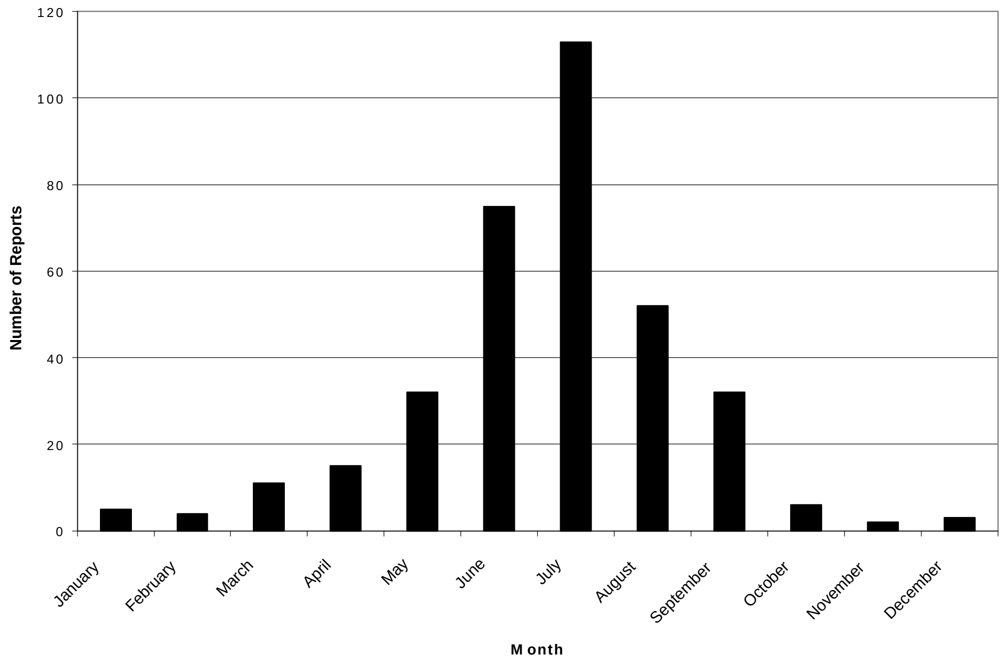

Figure 2-1. Heat Stress Events per Month

The following are the various forms of heat stress disorders, listed from most to least severe, and actions to take when they occur.

- Heat stroke is the most severe form of heat stress. This occurs when the body's system of temperature regulation fails and the temperature rises to critical levels. The primary signs of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; lack of sweating; hot, dry skin; and an abnormally high body temperature. This condition is caused by a combination of variable factors, and its occurrence is difficult to predict. Heat stroke is a medical emergency. If a worker shows signs of heat stroke, professional medical help should be obtained immediately. The worker should be placed in a shady area, and the outer clothing should be removed. The worker's skin should be wetted, and air movement around the worker should be increased to improve evaporative cooling. The worker should be given fluid replacement.

- Heat exhaustion symptoms are similar to those of heat stroke. The worker still sweats but experiences extreme weakness or fatigue, giddiness, nausea, or headache. Workers suffering from heat exhaustion should be removed from the hot environment and given fluid replacement.

- Heat cramps are painful spasms of the muscles resulting from an electrolyte imbalance caused by sweating and can be the result of too much or too little salt. Tired muscles are usually the ones most susceptible to cramps. The worker should be given fluid replacement

- Fainting (heat syncope) may be a problem for the worker unacclimatized to a hot environment.

- Heat rash, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep, impedes a worker's performance, or even results in temporary total disability.

The ACGIH establishes threshold limit values for work in hot environments. Threshold limit values are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a body core temperature of 100.4 degrees Fahrenheit. In some cases, work planners may want to equip workers in hot environments with portable heat stress monitors. These may be useful when heat conditions are difficult to predict and remote monitoring of worker health is desired.

Facility managers should review procedures for preparing work packages to ensure that the reviews are performed correctly and heat stress conditions are identified. They should also ensure that all work-related hazards are evaluated before work begins to reduce worker exposure to hazards and to prevent injuries.

- ACGIH publication, *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,* is a yearly publication that establishes maximum stay times for work in hot environments.

- OSHA Technical Manual, section III, chapter 4, "Heat Stress," provides discussions on causes, effects, and controls of heat stress.

- DOE/EH-0256T, *Radiological Control Manual*, table 3-1, provides guidelines for selecting the appropriate protective clothing. Chapter 3 of the manual provides guidance for proper personnel protective equipment and clothing. Chapter 5, Article 534, discusses heat stress considerations and states that supervisors should inform their personnel of heat stress precautions before beginning work on job assignments in hot environments.

The OSHA Technical Manual and other useful heat stress references are available at the OSHA Heat Stress Technical Links web page at http://www.osha-slc-gov/sltc/heatstress/. A worker aid, referred to as the "Heat Stress Card," is available from OSHA at http://www.osha-slc.gov/Publications/osha3154.pdf. *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* may be ordered from the American Council of Governmental Industrial Hygienists at http://www.acgih.org.

KEYWORDS: heat stress, hazard analysis, personal protective equipment

FUNCTIONAL AREAS: Industrial Safety, Work Planning

3. WORKER SPREADS CONTAMINATE WITH AIR HOSE

On July 30, 1999, at the Ames Laboratory, a subcontract worker used an air hose to clean up calcium silicate particulate material from insulation used on the exhaust system of an emergency generator and spread contaminate in the room he was working in and an adjacent room. The Material Safety Data Sheet (MSDS) for the insulation states that dry sweeping or compressed air are not to be used for clean up. The worker received an acute exposure to the dust in sufficient concentration to irritate his upper respiratory tract, resulting in coughing. He recovered after a few minutes and no long-term health effects are expected. The cloud of particulate caused a smoke detector to alarm, resulting in a building evacuation and fire department response. Personnel returned to the building after the situation was controlled. The facility manager instructed the subcontract worker to leave the facility and notified his employer about the incident. The subcontractor's failure to adhere to the precautions and safe handling instructions in the MSDS resulted in the spread of material that is a skin and eye irritant and an inhalation hazard. (ORPS Report CH--AMES-AMES-1999-0004)

A facility manager representative investigated the event and determined that the worker did not follow the information on the MSDS for the product being used, failed to evacuate the building when the fire alarm sounded, and wasn't wearing respiratory protection while using the air hose. He determined that the worker had 6 to 7 years experience working with calcium silicate insulation.

NFS reported other events in the Weekly Summary about personnel not following information in a product MSDS. Some examples follow.

- Weekly Summary 98-27 reported that three reactor auxiliary operators at the Idaho National Engineering and Environmental Laboratory Advanced Test Reactor were exposed to trimethylamine above the short-term 15-minute exposure limit while recharging anion exchange resin in a demineralizer tank. Investigators believed that storing drums of resin at a temperature higher than recommended on the MSDS caused excessive off-gassing of trimethylamine. (ORPS Report ID--LITC-ATR-1998-0014)

- Weekly Summary 96-05 reported that two operators and a health physicist at Hanford Analytical Laboratory were exposed to hazardous vapors while working in a contamination confinement structure. The exposure resulted from operators wearing powered air purifying respirators that were inappropriate for the confined atmosphere. Investigators determined that operators did not review the MSDS for a stripcoat they were using during the pre-job briefing or when preparing the work package. (ORPS Report RL--WHC-ANALLAB-1996-0006)

These events underscore the importance of reading and following the safety and hazards information provided on the MSDS. The MSDS not only provides information about chemical ingredients, reactivity, transportation, and disposal, but also about health hazards, control measures, and fire and explosion data. In the Ames Laboratory event, the MSDS for the calcium silicate insulation recommended using either a vacuum to minimize airborne dusts or a dust suppressant, such as water. The MSDS also advised that dry sweeping or compressed air should not be used for clean up. Along with information about handling and precautions, the MSDS provided control measures that addressed proper personal protective equipment, such as using respirators to avoid inhaling dust.

OSHA Standard 29 CFR 1910.1200, *Hazard Communication*, requires chemical manufacturers to provide new and updated data sheets to their distributors and customers. It also requires employers to maintain copies of MSDSs and to make them available to their employees. If the accuracy of a MSDS is in question, facility industrial hygienists or safety engineers should contact the distributor or manufacturer to obtain a current one. If the manufacturer or distributor cannot be located, analyzing the chemical at a certified chemical laboratory should be considered.

KEYWORDS: compressed air, dust, industrial hygiene, insulation, particulate, respirator

FUNCTIONAL AREAS: Industrial Safety, Chemistry

4. LABORER'S LEG ENTANGLED IN TAG LINE DURING CRANE OPERATION

On August 4, 1999, at the Rocky Flats Environmental Technology Site, Solar Ponds Plume Project, a laborer's leg became entangled in a tag line attached to a load being moved by a crane operator. The laborer was acting as a spotter for the operator, and the line pulled him off balance before the crane operator noticed what happened. Because the crane operator could not see the spotter's lower body, he did not immediately notice the spotter's leg was entangled. However, he did notice the spotter looked distressed, so he stopped operations. The spotter untangled his leg from the tag line, regained his composure, completed the lift, and notified his foreman of the event. Although the spotter was not injured, the line lifted his leg approximately to his waist before the crane stopped. Failure to observe safe hoisting and rigging practices can lead to the loss of positive control of loads and can result in personnel injuries. (ORPS Report RFO--KHLL-ENVOPS-1999-0004)

Investigators determined that the crane operator and spotter had already performed several lifts to move equipment out of an excavated pit area. They were moving the last load when the spotter's leg became entangled. Investigators determined that the spotter had tied the tag line onto the load to provide personnel at the lay-down area a means of controlling the load. After tying the tag line onto the load, the spotter tossed it away and signaled the crane operator to raise the load. When the spotter realized he was caught in the line, he tried to signal the crane operator to stop the movement. However, as he started to fall, the spotter moved his signal hand from a level position to a vertical position, which is a signal for the crane operator to rotate the load. The operator had rotated the load, rotating the spotter's leg approximately 2 ft, before he noticed that the spotter looked distressed, heard him yelling, and stopped the crane.

The facility manager held a fact-finding meeting. Meeting attendees learned that site safety procedures require personnel to notify their immediate supervisor before continuing work when unforeseen safety problems occur. The facility manager directed hoisting and rigging personnel to complete the following corrective actions.

- Maintain control of the entire tag line when using them by rolling-up any excess length and feeding it out as necessary.

- Use an intermediate signal person if the crane operator does not have a clear view of the spotter.

- Evaluate conditions before continuing work when unusual events happen.

NFS has reported numerous hoisting and rigging events in several Weekly Summaries. Some examples follow.

- Weekly Summary 99-13 reported that a strongback dislodged from a docking plate and fell approximately 6 ft into a storage well at the Idaho National Engineering Environmental Laboratory Advanced Test Reactor. Riggers had accidentally snagged and lifted it while moving an irradiation test vehicle inpile tube assembly with a 10-ton bridge crane. A crane spotter saw the strongback snag the inpile tube assembly, signaled the crane operator to stop, and saw the strongback begin to fall. He moved out of the way of the strongback and its attached lifting bails to avoid being struck as they fell uncontrolled into the storage well, contacted and structurally damaged the docking plate, and contacted and chipped concrete from the reactor main floor. (ORPS Report ID--LITC-ATR-1999-0008)

- Weekly Summary 98-26 reported two events involving personnel injuries that occurred during hoisting and rigging operations. At the Ashtabula Decommissioning Project, a subcontractor ironworker received multiple fractures to his leg when he tried to control a swinging bundle of structural steel beams being lifted by a crane. The load struck other structural steel components in the lay-down area, causing a scissor effect of two pieces of steel that pinched the right leg of the ironworker. At the Lawrence Livermore National Laboratory, a subcontractor steelworker was injured at the construction site when his head was trapped between a steel truss beam and an outrigger on a crane, causing lacerations to his temple area from his aluminum hard hat. (ORPS Reports OH-AB-RMI-RMIDP-1998-0003 and SAN--LLNL-LLNL-1998-0034)

These events illustrate the importance of ensuring that all aspects of a lift are evaluated for potential hazards and that any actions to mitigate identified hazards are implemented. Becoming entangled in rigging equipment can be extremely dangerous. Workers should be aware of their environment and know when the potential to become entangled exists. The Rocky Flats event underscores the importance of maintaining unobstructed observation paths between crane spotters and crane operators. It also underscores the importance of an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. Workers should be trained to stop work and report conditions identified during work that is unsafe or inconsistent with expected conditions.

Facility managers, work planners, and crafts personnel should review the following references, when preparing for hoisting and rigging activities.

- DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, encourages the involvement of employees in identifying and controlling hazards in the workplace and describes the required elements of a worker protection program at DOE facilities. Attachment 2, “Contractor Requirements Document,” states that workers shall be informed of foreseeable hazards and required protective measures before starting work on the affected operation.

- DOE-STD-1090-99, *Hoisting and Rigging*, provides guidance for hoisting and rigging and identifies related codes, standards, and regulations. Chapter 6, “Personnel Qualification and Training,” specifies training requirements for equipment operators and riggers. Section 9.5.8, “Moving the Load,” specifies the use of tag lines to guide, snub, or otherwise control the load.

- DOE Office of Oversight publication, *Independent Oversight Special Study of Hoisting and Rigging Incidents Within the Department of Energy,* October 1996, presents an analysis of DOE hoisting and rigging incidents between October 1, 1993, and March 31, 1996. This study showed that three out of four hoisting and rigging incidents resulted in an accident where personal injury, property damage, or both was incurred. Half of all hoisting and rigging incidents are associated with the use of crane equipment. Seventy-four percent of crane incidents resulted in accidents. Inattention to detail, closely followed by deficiencies in work organization and planning, are the leading causes of crane incidents. This special study can be found at http://tis.eh.doe.gov/web/eh2/reviews/hoist_rig.html.

KEYWORDS: hoisting and rigging, near miss, occupational safety, construction, crane

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

5. EMERGENCY DIESEL GENERATOR BREAKER FAILS TO OPEN ON TRIP SIGNAL

On July 22, 1999, at the Savannah River F-Canyon Facility, an emergency diesel generator output breaker failed to open in response to a trip signal following a load test to verify the operability of protective relays. The generator motored for approximately 3 hours while facility operators and engineers investigated the trip failure and evaluated recovery methods that would not impact power to vital loads. An operator tripped the output breaker mechanically at the breaker front as another operator prepared to manually isolate fuel to the diesel engine, if necessary. Maintenance personnel removed the breaker to inspect it. They also inspected the generator and diesel for damage and replaced the diesel fuel injectors because they showed signs of wear. However, engineers do not believe that the wear was caused by the motoring event. Facility personnel retested the diesel generator and output breaker and placed them back in service on July 28. This occurrence is significant because generator motoring can cause significant damage to electrical generating equipment. (ORPS Report SR--WSRC-FCAN-1999-0019)

Figure 5-1 is a simplified diagram of the emergency power scheme. The load test consists of simulating a power outage to the emergency bus and verifying the ability of the diesel generator to start, pick up load, and maintain emergency loads. At the end of the test, utility power is paralleled with the diesel generator through the normal power supply breaker, and emergency bus load is gradually transferred from the diesel generator to utility power. When generator load is reduced to 300 amperes, the operator presses a STOP button on the generator control panel, sending an electric trip signal to the control logic for diesel generator output breaker and shutting down the diesel by tripping the fuel racks. However, when the operator pressed the STOP button, he noticed that the diesel generator output breaker did not open, and the diesel generator continued to run. He also noticed that the generator ammeter indicated 285 amperes, and the generator power meter indicated zero.

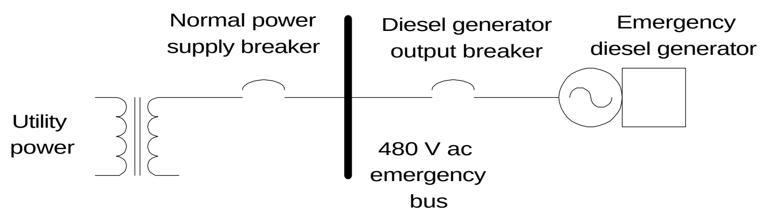

Figure 5-1. Simplified Emergency Power Scheme

The failed breaker, a Brown Boveri Model LK20, is equipped with auxiliary switch contacts in series with a breaker trip coil that energizes to trip the breaker. The contacts close when the breaker closes to align the trip coil to electric trip circuits and are operated mechanically by the breaker mechanism. Troubleshooting revealed that these contacts were not closed while the breaker was closed. Consequently, the breaker failed to trip, although all upstream logic (manual trip, lockout, and reverse power) operated normally.

Investigators determined that the diesel fuel racks tripped as required and the generator had been motoring from the time that the operator pressed the STOP button. Facility personnel determined that the auxiliary contacts failed to close properly because they were dirty.

Generator motoring is a reversal of the flow of power to a generator that causes it to operate as a motor, with the prime mover as a load. Motoring can occur when the frequency of a generator is significantly lower than the frequency being maintained by other generators operating in parallel with it. In this occurrence, no force was being applied to the generator by the diesel engine. Typically, the power required to motor a diesel generator is 25 percent of the generator nameplate rating in kilowatts. In this occurrence, 285 amperes correspond to approximately 19 percent of generator rating. The power meter read zero because it was not capable of indicating reverse power. Facility managers and supervisors should ensure that training programs for personnel who operate generating equipment contain information on generator motoring, its causes, and indications of motoring specific to facility installations.

KEYWORDS: circuit breaker, emergency diesel generator, test

FUNCTIONAL AREAS: Electrical Maintenance, Surveillance

6. CLASS IV LASER INTERLOCK FAILS DURING OPERATION

On August 6, 1999, at the Brookhaven National Laboratory, laser safety assessors from the DOE Brookhaven Group discovered that an interlock for a laser controlled area containing a Class IV excimer (XeCl) laser failed during a laser safety assessment. The interlock, which is designed to shut off the operating laser when the door to the laser controlled area is opened, failed to remove power to the laser as anticipated. Investigators determined that the laser interlock failed as a result of an electrical problem. A properly designed interlock system should be fail-safe (fail in a zero energy state). Class IV excimer lasers, which operate in the ultraviolet region, pose hazards to both the eyes and skin. The failure of safety interlocks to shut off operating lasers or prevent them from operating can result in personnel injury. (ORPS Report CH-BH-BNL-BNL-1999-0017)

The laser safety assessors were conducting an assessment to verify that Chemistry Department lasers were being operated in accordance with the guidance provided in ANSI Z136.1-1993, *American National Standard for the Safe Use of Lasers*. Because of the large number of lasers in the laser controlled area, the assessors selected this laser at random to verify operability of the interlock safety features. When the operation of the interlock failed, the assessors notified the Laboratory laser safety officer. The laser safety officer notified the Chemistry Department Chair and immediately took the laser out of service. Use of the laser will not resume until the interlock system is repaired and tested. The assessors also learned that the interlock test log documented that the interlock had passed a quarterly test in July. However, the Class IV laser tested during this laser safety assessment had not been tested during the July interlock test. They also learned that this laser laboratory did not have an interlock test procedure. Laser interlock systems should be tested periodically using an interlock test procedure.

NFS has reported other events in the Weekly Summary concerning laser interlocks that were not in service when the lasers were operating. Some examples follow.

- Weekly Summary 99-19 reported that safety personnel at the Brookhaven National Laboratory found that a laser interlock for an experiment on one of the beam lines at the National Synchrotron Light Source had been taped closed. This bypassed the intended interlock function for the Class IV laser. Two visiting researchers (trained and qualified in the use of the laser) had bypassed the interlock to determine if the laser was operating properly. While the interlock, which prevents personnel exposure to the laser beam, was bypassed, the researchers held a screen that was sensitive to the laser wavelength in the path of the laser beam and watched the screen fluoresce. (ORPS Report CH-BH-BNL-NSLS-1999-0003)

- Weekly Summary 99-13 reported that a safety and health inspector at the Lawrence Livermore National Laboratory performing routine laser interlock inspections discovered a guest researcher operating an open beam, Class II laser without authorization. Investigators determined that the guest had operated the laser with the interlocks bypassed and without an approved project work plan. He had also operated a Class IIIB cadmium/helium laser with the interlocks bypassed and without an approved project work plan. (ORPS Report SAN--LLNL-LLNL-1998-0007)

These events illustrate the importance of ensuring that laser safety interlocks are functional and perform as expected under all conditions. It is essential to conduct laser operations in accordance with approved safe operating procedures. A laser safety officer should approve all operations where interlocks may need to be bypassed (such as during maintenance or testing), but only in accordance with procedures. ANSI Z136.1-1993 defines a Class I laser as the least hazardous and a Class IV laser as the most hazardous. The standard states that a Class IV laser shall only be operated in areas specifically designated for laser operation and that it should be an enclosed room or laboratory with walls or barriers that block laser radiation. Access doors to a controlled laser area are to be equipped with fail-safe safety interlocks. The standard provides guidance for the safe use of lasers and laser systems by defining hazard control measures for each of the four laser classes.

Control measures include (1) engineering controls, such as beam housings, interlock systems, beam shutters, and attenuators; (2) administrative controls, such as procedures, warning signs, labels, and training; and (3) personal protective equipment, such as eyewear, gloves, and special clothing. This standard is endorsed in part by DOE O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, paragraph 12, "Contractor Requirements Document."

KEYWORDS: industrial safety, interlock, laser

FUNCTIONAL AREAS: Industrial Safety

FINAL REPORTS

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. UNDERGROUND UTILITY STRUCK BY DRILLERS

On March 10, 1999, at the Lawrence Livermore National Laboratory, drillers struck a 13.8-kV duct bank containing six conduits while excavating a test well with a rotary drill. The conduit they struck was not energized, and no one was injured. The drillers immediately stopped excavating work when they hit the duct bank. The facility manager stopped work on the test well, relocated workers to a new job site, and reapplied for permits to begin work at the new site. Investigators determined that an underground utility line locator performed an incomplete survey of underground utilities. They also determined that the technical administrative group, which oversees the soil permitting process, revised the permit procedure (MOP-02003) in May 1998, but drillers conducted the well drilling operation under an old blanket permit that did not contain the stronger controls established in May. Although this occurrence did not cause injuries, disturbing underground utilities reduces safety margins and can interrupt vital services. (ORPS Report OAK--LLNL-LLNL-1999-0008)

On August 12, 1998, a similar event occurred at the Lawrence Livermore National Laboratory. In this event, a backhoe operator struck an energized conduit, damaging the conduit, but not the enclosed wiring. Line locators tried twice to locate the conduit but were unable to find it. The facility manager attributed the direct cause of this event to personnel error because the line locator failed to perform a spot-specific underground search as required by MOP-02003. Hazards control personnel developed a lessons learned report on August 26, 1998, and distributed it to the entire Lawrence Livermore National Laboratory population. (ORPS Report OAK--LLNL-LLNL-1998-0048)

The facility manager attributed the March 10 event to the following causes.

Direct Cause: Personnel Error/Other Human Error — The line locator who performed the underground utilities location work said that the proposed site was clear of all underground utilities. The line locator reviewed plans that identified utilities near the area and verified their location. However, the plans did not show the duct bank. The locator did find the duct bank away from the well site, but he misidentified it as one of the utilities shown in the plans. The line locator did not use his equipment to detect the presence of underground utilities at the proposed test well location.

Contributing Cause: Procedure Problem/Defective or Inadequate Procedure — The underground utility-locating service did not use a written procedure or checklist. Their detection strategy relied on verifying the location of known utilities.

Root Cause: Management Problem/Inadequate Administrative Control — The underground utility-locating service lacked formality in their management structure, support, and oversight. Operating procedures adequate to prevent this incident might have been in place and used if these management elements had been strengthened.

The facility manager identified one corrective action. He committed resources to develop an operating procedure for future underground utility-locating services. The facility manager approved a target completion date of October 3, 1999.

Utility lines and cables have been buried on DOE property since the 1940s. Many of them are undocumented or poorly documented. The uncertainties surrounding the existence and precise locations of underground utilities demand special planning and execution of excavations. Along with verifying locations of known buried utilities using the best available drawings and appropriate detectors, utilities locators should verify the absence of unidentified utilities at the proposed ground penetration location.

DOE/EH-0541, Safety Notice 96-06, *Underground Utilities Detection and Excavation,* provides additional descriptions of excavation events. It describes technology for underground utility detection, specific recommendations for improving excavating programs, and innovative practices used at DOE facilities. The notice states that a central coordinator should not only assist in identifying underground utilities but should also record the findings. The notice also cites three principal causes of excavation and digging occurrences: (1) failure to detect underground utilities because of reliance on as-built drawings; (2) failure to use hand-digging because of the pressure of schedules; and (3) failure to detect underground utilities because detection devices were not used or were used ineffectively. Safety Notice 96-06 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety notices are also available on the OEAF home page at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ons.html.

Other sources for excavation safety information include the following.

- Hanford Lessons Learned No. 1998-RL-HNF-0026, available at http//www.hanford.gov/lessons/sitell/1998/199826.htm. This document provides the lessons learned from two excavation occurrences at Hanford and describes the bases for the Hanford excavation safety program.

- The OSHA technical link for trenching and excavation, available at http://www.osha-slc.gov/SLTC/trenchingexcavation/index.html.

KEYWORDS: cable, excavation, industrial safety, underground, utility

FUNCTIONAL AREAS: Construction, Industrial Safety

2. LIVE ROUND UNINTENTIONALLY FIRED DURING SECURITY TRAINING

On March 9, 1999, at the Los Alamos National Laboratory, a Protection Technology security officer unintentionally fired a live round from his revolver during a dry-fire practice conducted as part of his semiannual firearm requalification. The security officer had loaded what he believed were dummy rounds and began dry-firing at a target in a firing lane. His first shot fired a dummy round with no sound or report, as expected. However, he heard the second shot and felt his weapon recoil as a bullet discharged from his revolver, striking the target in the firing lane and impacting a berm behind the target. Although no personnel were injured in this event, serious injury or a fatality could have occurred as a result of mistakenly loading live ammunition. (ORPS Report ALO-LA-LANL-SECURITY-1999-0006)

The security officer was one of a team of officers practicing dry-firing from different positions using Smith and Wesson Model 19 revolvers. Firearm instructors ordered the officers to perform a self-check for live ammunition and considered the firing line to be safe. After a dry run of handgun presentation techniques, the instructors ordered the officers to load dummy rounds (rounds that have had the primer removed, have no powder, and have blunt solid tips) into their weapons from a dummy ammunition container. The instructors had ordered the officers to fire two dummy rounds at the targets when the unintentional discharge occurred.

The officer who fired the live round immediately removed his finger from the trigger and raised his hand to indicate a problem, as required by firing range safety procedures. A firearm instructor took control of the weapon, removed the casing of the round that fired, and cleared the revolver of all remaining ammunition. He ordered all security officers on the firing lines to inspect their firearms to ensure that no one else had loaded live rounds. Firing range instructors also inspected the dummy rounds remaining in the dummy-round container to ensure it held no live ammunition. Although the firing range staff agreed that there was no further safety hazard, the Protection Technology training manager discontinued the practice session.

Investigators determined that the dummy ammunition used in this type of dry-fire practice has been used at Los Alamos since 1988 with no prior incidents. Live ammunition is locked in a storage cabinet. Dummy ammunition is stored in an unlocked cabinet. Student officers are not permitted access to the dummy ammunition cabinet, but there are no barriers in place to prevent unauthorized access. Each officer is responsible for inspecting the ammunition when he takes it from the dummy ammunition container and loads it into his weapon to ensure that all loaded rounds are dummy rounds. When investigators questioned the officer about loading his revolver, he stated that he inspected the base of each round to ensure it was a dummy. He also stated that he could have been distracted for a moment and may not have properly inspected the round before loading it. Because dummy rounds are used in numerous practice sessions, their casings have a weathered (pitted and minute spots of rust) appearance. Although live ammunition generally has a clean and shiny appearance, the casing of the round fired had a similar weathered appearance. Investigators also determined that during dry-fire practice sessions officers unload their weapons onto an asphalt pad directly in front of the firing line. A security officer then picks up and removes the dummy rounds from the range for reuse in subsequent practice sessions. Investigators believe that during a dry-fire practice session the previous day an officer inadvertently picked up a live round of ammunition from the ground with the dummy rounds and unknowingly placed it into the dummy ammunition container. The live round discharged from the officer’s firearm was the only live round found by investigators.

Investigators determined that the direct cause of this event was Personnel Error, Procedure Not Used or Used Incorrectly, because the security officer did not follow the procedure that requires each officer to inspect the base of dummy ammunition before it is loaded. Additionally, the officer who picked up the live round and placed it in the dummy round container violated the procedure by not performing a dummy-round inspection. Investigators determined that the contributing cause was Procedure Problem, Lack of Procedure. The firing range staff periodically inspected the dummy ammunition to verify the integrity of dummy rounds and to ensure that live ammunition was not inadvertently introduced. However, this inspection was performed informally and with no set schedule. Investigators determined that the root cause of the event was Design Problem, Inadequate Work Environment. The dummy and live round casings were similar in appearance, and this similarity is compounded when a live round has a distressed appearance, as was the live-round casing in this event. Corrective actions implemented by Protective Technology Los Alamos managers include the following.

- Replace dummy ammunition constructed with unprimed casings and lead bullets with orange plastic dummy round ammunition.

- Revise the live fire range operations procedures to require an inspection of dummy round ammunition by a certified firearm instructor before issuance to security officers for use in dry-fire practice.

- Store dummy round ammunition in cartridge boxes with the primer side up and present the ammunition to training and qualifying officers in these boxes.

- Develop or procure dummy ammunition with casings that differ visually from live round ammunition.

This event illustrates that hazard analyses must not only assess hazards that could result in injury or damage, but must also analyze the hazards caused by procedure violations. Both the officer who placed the live round into the ammunition container and the one who loaded it into his weapon failed to follow procedures for handling dummy ammunition. Compliance with firearm safety procedures is essential in preventing firearm accidents. In 1994, a Protection Technology employee was fatally wounded during an engagement simulation exercise that required the use of blank ammunition. Another employee had accidentally loaded live ammunition into the weapon he used in the exercise (*Type A Investigation Report of a Fatal Shooting Accident During a Limited Scope Performance Test at LANL, December 1994*; ORPS Report ALO-LA-LANL-SECURITY-19994-0006). Although no damage or injury occurred during this event, inattention to procedural detail and inadequate engineering and administrative controls created an unacceptable impact on critical operations. DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter XVI, “Operations Procedures”, states that requirements for the use of procedures should be clearly defined and understood. It also states that procedures should be referenced during infrequent or unusual evolutions when errors could cause significant adverse impact.

KEYWORDS: administrative control, hazard analysis, inattention to detail, occupational safety, procedure

FUNCTIONAL AREAS: Conduct of Operations, Procedures, Security, Training and Qualification

PRICE-ANDERSON AMENDMENTS ACT (PAAA) INFORMATION

1. PRELIMINARY NOTICE OF VIOLATION AND PROPOSED CIVIL PENALTY AT PANTEX PLANT

On July 30, 1999, the DOE Office of Enforcement and Investigation issued a Preliminary Notice of Violation to Mason & Hanger Corporation (MHC) and proposed a civil penalty of $82,500 under the Price-Anderson Amendments Act (PAAA) for deficiencies in work controls and procedural violations at the Pantex Plant. The Preliminary Notice of Violation resulted from an investigation by Office of Enforcement and Investigation staff into the circumstances and potential consequences of an event involving an isopropyl alcohol fire in a weapons disassembly cell. Propagation of the fire in the cell could have resulted in the detonation of high-explosive material present in the cell and in worker injury or death. (NTS-ALO-AO-MHSM-PANTEX-1999-0001; Letter, DOE [D. Michaels] to Mason & Hanger Corporation [Dr. William Weinrich], 07/30/99)

On December 29, 1998, a flash fire occurred when isopropyl alcohol vapors ignited some kimwipes® while a production technician was using the alcohol and a wooden tongue depressor to remove sealant material from a weapon component. The production technician quickly extinguished the fire with a fire extinguisher. A Type C Accident Investigation Board determined the ignition source was either an electrostatic discharge or a frictional spark. (ORPS Report ALO-AO-MHSM-PANTEX-1998-0094; Weekly Summary 99-02 and 99-18)

A September 6, 1996, facility fire hazards analysis identified the hazard posed by isopropyl alcohol based on a previous alcohol fire that occurred at the Pantex Plant. However, MHC managers did not adequately implement actions to either eliminate the hazard through substitution of an alternative cleaning agent or mitigate the potential for a fire through explicit administrative and procedural controls. MHC established procedural controls that were inadequate to minimize the amount of alcohol used, ensure adequate ventilation to preclude the accumulation of concentrated vapors, or preclude electrostatic discharge as an ignition source.

The Preliminary Notice of Violation stated that areas of work controls and procedure compliance were contrary to the requirements of 10 CFR 830.120(2)(c)(i), which requires that work shall be performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means. These quality assurance violations, which resulted in a proposed civil penalty of $41,250 each, are delineated as follows.

Work Controls

Investigators determined that MHC managers did not develop and implement adequate work controls to prevent or mitigate the consequence of a fire for the work being performed in the cell on December 29, 1998. In particular, their actions and work process controls did not adequately address alcohol flammability concerns by eliminating the combustible environment associated with weapons work processes employing the alcohol. In addition, they did not sufficiently address or resolve work process controls for similar alcohol flammability issues raised during a weapons process preliminary hazards analysis conducted in August 1997.

Procedural Violations

Investigators determined that technicians did not perform component cleaning operations in accordance with established administrative controls and did not use approved instructions, procedures, or other appropriate guidance in the cell. The following procedural noncompliances occurred while production technicians were using a nuclear explosive operating procedure.

- Technicians did not perform the operation as a two-person step.
- Technicians stamped-off the procedural step for cleaning the component as complete, when it had not been completed.
- Technicians performed the procedural steps for the cleaning operation out of sequence.
- Technicians used a tool that was not authorized by the procedure (tongue depressor).
- Technicians did not remove excess materials and combustibles from the cell before the disassembly operations.
- Technicians failed to read the procedural steps before beginning the work.

All of the required actions were specified in the procedure for performing the cleaning operation. Also, an MHC standing order, dated December 29, 1997, required the use of a readiness checklist that specified removal of all unneeded materials and combustibles from the cell before disassembly operations. However, technicians did not remove all unneeded Scotchbrite pads and acetone from the cell.

DOE is concerned about this event because MHC managers identified the hazard following a previous operational event at the Pantex Plant. Although DOE and MHC discussed an alternative cleaning agent at that time, MHC managers failed to resolve the issue proactively or implement adequate controls to prevent or mitigate the consequences of a fire. As reflected in the DOE nuclear safety regulations and in the enforcement policy, DOE expects its contractors to take ownership of safety in their activities and to identify and correct safety weaknesses.

Under the provisions of the PAAA, DOE can fine contractors for violations of Department rules, regulations, and compliance orders relating to nuclear safety requirements. DOE contractors who operate nuclear facilities or who perform nuclear activities and fail to remain in compliance with such requirements could be subjected to Price-Anderson civil penalties for violating the provisions of 10 CFR 830.120, *Quality Assurance Requirements,* and/or 10 CFR 835, *Occupational Radiation Protection*. These actions include Notices of Violation and, where appropriate, nonreimbursable civil penalties.

The primary consideration for determining whether DOE takes enforcement action is the actual or potential safety significance of a violation, coupled with how quickly the contractor acts to identify and correct problems.

The Office of Enforcement and Investigation may reduce penalties when a DOE contractor promptly identifies a violation, reports it to DOE, and undertakes timely corrective action. DOE has the discretion not to issue a Notice of Violation in certain cases. Information on the DOE Enforcement and Investigation Program and copies of enforcement actions and letters are available at http://tis.eh.doe.gov/enforce.

KEYWORDS: conduct of operations, enforcement, explosive, fire, Price-Anderson Act, procedures

FUNCTIONAL AREAS: Explosive Safety, Fire Protection, Lessons Learned, Operations, Procedures

OEAF FOLLOWUP ACTIVITIES

1. OPERATING EXPERIENCE WEEKLY SUMMARY NOW AVAILABLE VIA E-MAIL

The Office of Nuclear and Facility Safety is now able to send a .pdf version of the OEWS directly to your e-mail. Here are just a few benefits you will see when you have an electronic copy sent “straight to your desktop.”

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